Exhibit 1
to
Visto's First Amended Answer to Research in Motion Limited's Complaint for Patent Infringement; Counterclaims Against Research in Motion Limited and Research in Motion Corporation

US007225231B2

(12) **United States Patent**
Mendez et al.

(10) **Patent No.: US 7,225,231 B2**
(45) **Date of Patent: May 29, 2007**

(54) **SYSTEM AND METHOD FOR TRANSMITTING WORKSPACE ELEMENTS ACROSS A NETWORK**

(75) Inventors: **Daniel J. Mendez**, Mountain View, CA (US); **Mark D. Riggins**, San Jose, CA (US); **Prasad Wagle**, Santa Clara, CA (US); **Christine C. Ying**, Foster City, CA (US)

(73) Assignee: **Visto Corporation**, Redwood Shores, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 289 days.

(21) Appl. No.: **09/921,228**

(22) Filed: **Aug. 1, 2001**

(65) **Prior Publication Data**

US 2002/0035618 A1 Mar. 21, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/666,877, filed on Sep. 20, 2000, now Pat. No. 6,708,221.

(51) **Int. Cl.**
G06F 13/00 (2006.01)

(52) **U.S. Cl.** **709/206**

(58) **Field of Classification Search** 709/248, 709/204, 205, 206, 203; 707/202, 203, 204; 711/161, 162

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,652,698	A	3/1987	Hale et al.
4,714,995	A	12/1987	Materna et al.
4,831,582	A	5/1989	Miller et al.
4,875,159	A	10/1989	Cary et al.
4,882,752	A	11/1989	Lindman et al.
4,897,781	A	1/1990	Chang et al.
4,916,738	A	4/1990	Chandra et al.
5,048,085	A	9/1991	Abraham et al.
5,150,407	A	9/1992	Chan

(Continued)

FOREIGN PATENT DOCUMENTS

CA	CA 2191505	6/1997
CA	CA 2210763	1/1999

(Continued)

OTHER PUBLICATIONS

Emmett Gray, "FETCH-O-MATIC by Emmett Gray", http://www.filmscouts.com/software/fomguide.asp, Version 2.5, 2001.*

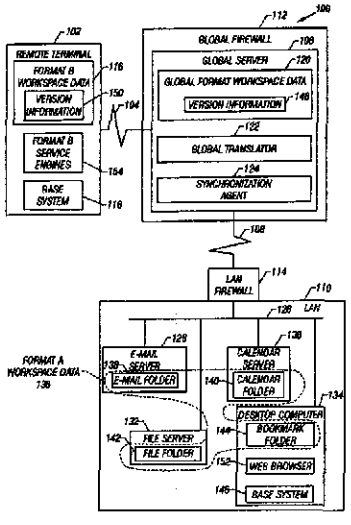
(Continued)

Primary Examiner—Robert B. Harrell
(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

(57) **ABSTRACT**

A system transmits new workspace elements or new workspace element changes at a first memory store via an electronic network to a second memory store. The system includes a first memory store for storing workspace elements; a second memory store coupled via an electronic network to the first memory store for storing workspace element copies; an interface for receiving new workspace elements at the first memory store; and a general synchronization module for electronically transmitting copies of the new workspace elements via the electronic network to the second memory store.

6 Claims, 5 Drawing Sheets



U.S. PATENT DOCUMENTS

5,220,603	A		6/1993	Parker
5,263,157	A		11/1993	Janis
5,265,159	A		11/1993	Kung
5,333,266	A	*	7/1994	Boaz et al. 709/206
5,386,564	A		1/1995	Shearer et al.
5,388,255	A		2/1995	Pytlik et al.
5,392,390	A		2/1995	Crozier
5,420,927	A		5/1995	Micali
5,425,102	A		6/1995	Moy
5,434,918	A		7/1995	Kung et al.
5,483,596	A		1/1996	Rosenow et al.
5,491,752	A		2/1996	Kaufman et al.
5,495,533	A		2/1996	Linehan et al.
5,510,777	A		4/1996	Pilc et al.
5,544,320	A		8/1996	Konrad
5,544,322	A		8/1996	Cheng et al.
5,572,643	A		11/1996	Judson
5,581,749	A		12/1996	Hossain et al.
5,588,132	A		12/1996	Cardoza
5,600,834	A		2/1997	Howard
5,604,788	A		2/1997	Tett
5,613,012	A		3/1997	Hoffman et al.
5,623,601	A		4/1997	Vu
5,627,658	A		5/1997	Connors et al.
5,627,997	A		5/1997	Bray et al.
5,632,011	A		5/1997	Landfield et al.
5,634,053	A		5/1997	Noble et al.
5,644,354	A		7/1997	Thompson et al.
5,647,002	A		7/1997	Brunson
5,652,884	A		7/1997	Palevich
5,657,390	A		8/1997	Elgamal et al.
5,664,207	A		9/1997	Crumpler et al.
5,666,530	A	*	9/1997	Clark et al. 707/201
5,666,553	A		9/1997	Crozier
5,675,782	A		10/1997	Montague et al.
5,678,039	A		10/1997	Hinks et al.
5,680,542	A		10/1997	Mulchandani et al.
5,682,478	A		10/1997	Watson et al.
5,682,524	A		10/1997	Freund et al.
5,684,951	A		11/1997	Goldman et al.
5,684,984	A		11/1997	Jones et al.
5,684,990	A		11/1997	Boothby
5,687,322	A		11/1997	Deaton et al.
5,701,400	A		12/1997	Amado
5,701,423	A		12/1997	Crozier
5,706,427	A		1/1998	Tabuki
5,706,502	A		1/1998	Foley et al.
5,710,918	A		1/1998	Lagarde et al.
5,710,922	A		1/1998	Alley et al.
5,713,019	A		1/1998	Keaten
5,715,403	A		2/1998	Stefik
5,717,925	A		2/1998	Harper et al.
5,721,779	A		2/1998	Funk
5,721,908	A		2/1998	Lagarde et al.
5,721,914	A		2/1998	DeVries
5,727,202	A		3/1998	Kucala
5,729,735	A		3/1998	Meyering
5,742,668	A		4/1998	Pepe et al.
5,745,360	A		4/1998	Leone et al.
5,752,059	A		5/1998	Holleran et al.
5,752,246	A		5/1998	Rogers et al.
5,754,830	A		5/1998	Butts et al.
5,757,916	A		5/1998	MacDoran et al.
5,758,150	A		5/1998	Bell et al.
5,758,354	A		5/1998	Huang et al.
5,758,355	A		5/1998	Buchanan
5,764,902	A		6/1998	Rothrock
5,765,171	A		6/1998	Gehani et al.
5,768,510	A		6/1998	Gish
5,778,346	A		7/1998	Frid-Nielsen et al.
5,778,389	A	*	7/1998	Pruett et al. 707/204
5,784,463	A		7/1998	Chen et al.
5,784,464	A		7/1998	Akiyama et al.
5,787,172	A		7/1998	Arnold
5,790,425	A		8/1998	Wagle
5,790,790	A		8/1998	Smith et al.
5,790,974	A		8/1998	Tognazzini
5,794,252	A		8/1998	Mosher
5,799,086	A		8/1998	Sudia
5,799,318	A		8/1998	Cardinal et al.
5,802,530	A		9/1998	Van Hoff
5,812,398	A		9/1998	Nielsen
5,812,668	A		9/1998	Weber
5,812,773	A		9/1998	Norin
5,815,683	A		9/1998	Vogler
5,818,935	A		10/1998	Maa
5,828,840	A		10/1998	Cowan et al.
5,832,483	A		11/1998	Barker
5,835,087	A		11/1998	Herz et al.
5,835,601	A		11/1998	Shimbo et al.
5,845,282	A		12/1998	Alley et al.
5,862,325	A		1/1999	Reed et al.
5,862,346	A		1/1999	Kley et al.
5,870,544	A		2/1999	Curtis
5,870,759	A		2/1999	Bauer et al.
5,870,765	A		2/1999	Bauer et al.
5,878,230	A		3/1999	Weber et al.
5,909,689	A		6/1999	Van Ryzin
5,924,103	A		7/1999	Ahmed et al.
5,928,329	A		7/1999	Clark et al.
5,943,676	A		8/1999	Boothby
5,951,652	A		9/1999	Ingrassia, Jr. et al.
5,961,590	A		10/1999	Mendez et al.
5,966,714	A		10/1999	Huang et al.
5,968,131	A		10/1999	Mendez et al.
5,974,238	A	*	10/1999	Chase, Jr. 709/248
5,982,898	A		11/1999	Hsu et al.
5,987,609	A		11/1999	Hasebe
5,999,932	A		12/1999	Paul
5,999,947	A		12/1999	Zollinger et al.
6,006,017	A		12/1999	Joshi et al.
6,006,274	A	*	12/1999	Hawkins et al. 709/248
6,020,885	A		2/2000	Honda
6,021,427	A		2/2000	Spagna et al.
6,023,700	A		2/2000	Owens et al.
6,023,708	A		2/2000	Mendez et al.
6,034,621	A		3/2000	Kaufman
6,052,735	A		4/2000	Ulrich et al.
6,073,165	A		6/2000	Narasimhan et al.
6,085,192	A	*	7/2000	Mendez et al. 707/10
6,094,477	A		7/2000	Nada et al.
6,125,281	A		7/2000	Wells et al.
6,108,691	A		8/2000	Lee et al.
6,108,709	A		8/2000	Shinomura et al.
6,118,856	A		9/2000	Paarsmarkt et al.
6,131,096	A		10/2000	Ng et al.
6,131,116	A		10/2000	Riggins et al.
6,138,146	A		10/2000	Moon et al.
6,151,606	A		11/2000	Mendez
6,154,844	A		11/2000	Touboul et al.
6,169,986	B1		1/2001	Bowman et al.
6,182,118	B1		1/2001	Finney et al.
6,212,529	B1		4/2001	Boothby et al.
6,249,805	B1		6/2001	Fleming, III
6,295,541	B1		9/2001	Bodnar et al.
6,304,881	B1		10/2001	Halim et al.
6,311,186	B1		10/2001	Melampy et al.
6,324,542	B1		11/2001	Wright, Jr. et al.
6,334,140	B1		12/2001	Kawamata
6,343,313	B1		1/2002	Salesky et al.
6,389,455	B1		5/2002	Fuisz
6,438,583	B1		8/2002	McDowell et al.
6,446,090	B1		9/2002	Hart
6,477,545	B1		11/2002	LaRue

	6,510,455 B1	1/2003	Chen et al.
	6,564,218 B1	5/2003	Roth
	6,631,416 B2	10/2003	Bendinelli et al.
	6,697,942 B1	2/2004	L'Heureux et al.

FOREIGN PATENT DOCUMENTS

CA	2210763	2/2000
EP	0 801 478	10/1997
EP	EP 0801478	10/1997
EP	EP 0820028	1/1998
JP	JP 02000003314	1/2000
WO	WO 96/17306	6/1996
WO	WO 97/04389	2/1997
WO	WO 97/24678	7/1997
WO	WO 97/35265	9/1997
WO	WO 99/05620	2/1999
WO	WO 99/45451	9/1999
WO	WO 00/22543	4/2000
WO	PCT 2002/0138599	9/2002
WO	PCT 2002/0174372	11/2002

OTHER PUBLICATIONS

Research Disclosure; "Provide Auto-Forwarding Based on Criteria Selected by the User"; Oct. 1, 1989; 1 page; No. 306; Kenneth Mason Publications; XP000085405; ISSN; 0374-4353.

Bellovin, Steven M. et al., "Network Firewalls," IEEE Communications Magazine, Sep. 1994, pp. 50-57.

Braun, Hans-Werner, et al., "Web Traffic Characterization: An Assessment of the Impact of Caching Documents from NCSA's Web Server," Computer Networks and ISDN Systems, 1995, pp. 37-51, vol. 28.

Brown, Margaret J., "The Visto Briefcase Pro Puts Your PIM On The Internet," Aug. 13, 1998, 1 page. URL:http://www.zdnet.com/zdnn/stories/zdnn_display/0,3440,341892,00.html.

Cobb, S., Director of Special Projects National Computer Security Association, "Establishing Firewall Policy," Jun. 25-27, 1996, pp. 198-205, ISBN# 0-7803-3268-7.

Greenwald, Michael, et al., "Designing an Academic Firewall: Policy, Practice, and Experience With SURF," Proceedings of SNDSS 1996, 1996 IEEE, Feb. 22, 1996, pp. 79-92.

Kiuchi, Takahiro, et al., C-HTTP—The Development of a Secure, Closed HTTP-based Network on the Internet, Proceedings of SNDSS 1996, 1996 IEEE, Feb. 22, 1996, pp. 64-75.

Marinacci, Enzo, "Bookmark Translator 2.0—This Utility Transform Microsoft Internet Explore's Bookmarks in the Format Valid for Netscape Nagivator and vice versa," Jul. 1997, 4 pages, Published in Rome, Italy. URL:http://www.bns.it/EMware/Bookmark/Translator-uk.html.

Nelson, Ruth, et al., "Security for Infinite Networks," 1995 IEEE, Aug. 22, 1995, pp. 11-19.

Stempel, Steffen, "IpAccess—An Internet Service Access System for Firewall Installations," 1995 IEEE, Feb. 16, 1995, pp. 31-41.

Radosevich, Linda, "Users want unified mail directories,"Computerworld, Aug. 30, 1993, p.12.

Bruno, Charles, "Firm pushes E-mail limits beyond rivals'," Network World, Aug. 12, 1991, pp. 33, 53.

Sliwa, Carol and Cole, Barb, "MESA declares a groupware detente," Network World, Aug. 5, 1996, p. 29.

Grosse, Eric, "Repository Mirroring," ACM Transactions on Mathematical Software, vol. 21, No. 1, Mar., 1995, pp. 89-97.

Schilit, Bill N. and Theimer, Marvin M., "Disseminating Active map Information to Mobile Hosts," IEEE Network, Sep./Oct. 1994, pp.22-32.

Levy, Eliezer and Silberschatz, Abraham, "Distributed File Systems: Concepts and Examples," ACM Computing Surveys, Vol. 22, No. 4, Dec. 1990, p. 321-74.

Rymer, John R., "The Muddle in the Middle," Byte, Apr. 1996, pp. 67-70.

Baum, David, "Intranet Politics and Technologies," Byte, May 1997, pp. 88A-88H.

Udell, Jon, "Push Me, Pull You," Byte, Sep. 1996, pp. 117-120.

Kador, John, "The Ultimate Middleware," Byte, Apr.1996, pp. 79-83.

Brown, Mark, "Using Netscape 2," Que Corporation, 1995, pp. 885-907.

Kramer, Douglas, "The Java Platform," Javasoft, May 1996, pp. 1-25.

Package java.applet; java.net, http://www-nrg.ee.lbl.gov/j4/apibook/javaf.htm, javam.htm, Apr. 22, 1996.

Servlet Tutorial, http://mech.postech.ac.kr/Java/java.sun.com/products/jeeves/currentrelease/doc/servlet_tutorial/servlet_tutorial.html.

Freier et al., entitled "The SSL Protocol, Version 3.0,"Netscape Communications, dated Nov. 18, 1996, pp. 1-59, Downloaded from URL=http://www.home.netscape.com/eng/ss13/draft302.txt.

Java Servlet Application Programming Interface White Paper, http://mech.postech.ac.kr/Java/java.sun.com/products/jeeves/CurrentRelease/doc/api.html, Aug. 1996, pp. 1-6.

Singhal, M., "Update transport: A new technique for update synchronization in replicated database systems," IEEE Transactions on Software Engineering, vol. 16, No. 12, Dec. 1990, pp. 1325-1336.

Rao, H. & Skarra, A., "A transparent service for syncronized replication across loosely-connected file systems," IEEE Transactions on Software Engineering, Apr. 1995, pp. 110-117.

Crispin, M., "Internet Message Access Protocol - RFC 1730 Version 4," Dec. 1994, pp. 1-52, http://faqs.org/rfcs/rfc1730.html.

Rao, Venkat & Aline, Mary, "Burrowing through firewalls," Dec. 1996, pp.1-5, http://java.sun.com/developer/technicalArticles/InnerWorkings/Burrowing/.

Brown, Margaret J., "The Visto Briefcase Pro Puts Your PIM On The Internet," Aug. 13, 1998, 1 page, URL:http://www.zdnet.com/zdnn/stories/zdnn_display/0,3440,341892,00.html.

Tanenbaum, Andrew, "Computer Networks," Third Edition, Prentice-Hall, 1996, see entire document.

Knudsen, Jonathan, "Java Cryptography," O'Reilly, 1998, pp. 79-91, 112, 160.

Verisign Press Release, "Verisign Enhances Digital IDS to Enable Universal Website Login and One-step Registration," <www.verisign.com/press/product/isv.html>, especially 2nd paragraph.

Crispin, M., "IMAP4 Compatibility With IMAP2BIS", Network Working Group RFC 2061, Dec. 1996, XP002154026, <URL:http://www.imc.org/rfc2061>, retrieved Nov. 28, 2000, page 1, last paragraph.

"Configuration of a wireless-connected mobile computer," IBM Technical Disclosure Bulletin, US, IBM Corp., New York, vol. 38, No. 4, Apr. 1, 1995, pp. 15-17, XP000516057, ISSN: 0018-8689, the whole document.

Mason, Justin, "Tunneling over HTTP," Dec. 11, 1996, pp. 1-2 http://www.netsys.com/firewalls/firewalls-9612/0488.html.

Elgamal, Taher, "The Secure Sockets Layer Protocol (SSL)," agenda for the Danvers IETF Meeting, Apr. 1995, pp. 1-5 - http://www.ietf.cnri.reston.va.us/proceedings/95apr/sec/cat.elgamal.slides.html.

Research Disclosure: "Provide Auto-Forwarding Based On Criteria Selected by the User"; Oct. 1, 1989; 1 page; No. 306; Kenneth Mason Publications; XP000085405; ISSN 0374-4353.

Chan, M.C. et al., "Applications of Compaction Technique to Optimizi ng Wireless Email Transfer," IEEE Wireless Communications and Networking Conference 1999, p. 1535 Section A.

Crispin, M., "Internet Message Access Protocol Version 4rev1," 1996 Section 2.3.1.1.

Jaeger and Prakash, "Implementation of a Discretionary Access Control Model for Script-based Systems," IEEE Jun. 1995.

Adams, Charlotte, "Multilevel Secure Networking Charges Ahead," Federal Computer Week, Apr. 12, 1993.

Kohl, John, "The Evolution of the Kerberos Authentication Service," 1991.

Young et al., "Deniable Password Snatching: On the Possibility of Evasive Electronic Espionage," 1997, IEEE, p. 224-35.

Abel, Amee, "E-mail anywhere," May 1998, Time, pp. 1-4.

Satyanarayanan, M., "Integrating Security in a Large Distributed System," ACM Transactions on Computer Systems, vol. 7, No. 3, Aug. 1989, p. 247-80.

Kistler, James J. and Satyanarayanan, M., "Disconnected Operation in the Coda File System," ACM Transactions on Computer Systems, vol. 10, No. 1, Feb. 1992, pp. 3-25.
Hills, Alex and Johnson, David B., "Wireless Data Network Infrastructure at Carnegie Mellon University," IEEE Personal Communications, 3(1), Feb. 1996.
Satyanarayanan, Mahadev, "Mobile Information Access," IEEE Personal Communications, Feb. 1996, pp. 26-33.
Satyanarayanan, Mahadev et al., "Coda: A Highly Available File System for a Distributed Workstation Environment," IEEE Transactions on Computers, vol. 39, No. 4, Apr. 1990, p. 457-59.
Satyanarayanan, Mahadev, "Scalable, Secure, and Highly Available Distributed File Access," Computer, May 1990, pp. 9-21.
Mummert, Lily B. et al., "Exploiting Weak Connectivity for Mobile File Access," SIGOPS '95, Dec. 1995, p. 143-55.
Terry, Douglas B. et al., "Managing Update Conflicts in Bayou, a Weakly Connected Replicated Storage System," SIGOPS '95, Dec. 1995, pp. 172-183.
Demers, Alan et al., "The Bayou Architecture: Support for Data Sharing among Mobile Users," Proceedings of the Workshop on Mobile Computing Systems and Applications, Santa Cruz, California, Dec. 1994, pp. 2-7.
Petersen, Karin et al., "Bayou: Replicated Database Services for World-wide Applications," Proceedings Seventh ACM SIGOPS European Workshop (EuroSIGOPS '96), Connemara, Ireland, Sep. 1996, pp. 275-280.
Crocker, David H., "RFC822: Standard for ARPA Internet Text Messages," http://www.w3.org/Protocols/rfc822/.
Theisen, Tim, "AFS distributed filesystem FAQ (1/2)," posted to uwisc.general newsgroup, Jul. 25, 1994.
Theisen, Tim, "AFS distributed filesystem FAQ (2/2)," posted to uwisc.general newsgroup, Jul. 25, 1994.
Schubert, Eric, "Re: telnet/internet and ... ," posted to comp.sys.hp.mpe newsgroup, Jun. 30, 1995.
Glazman, Daniel, "SOFTWARE:HHTPtool [sic] 1.1, a file transfer utility over HTTP using PUT and GET," posted to comp.infosystems.www.announce newsgroup, May 17, 1995.
Glazman, Daniel, "*SOFTWARE:HHTPtool v1.0 for Windows3.x*, file transfer utility over HTTP," posted to comp.infosystems.www.announce newsgroup, Mar. 21, 1996.
Angus, Jeffrey G., "Sales force automation has a GoldMine," Computerworld, Oct. 7, 1996, p. 59.
Salamone, salvatore, "Middle(ware) Management," Byte, Apr. 1996, pp. 71-76.
Nance, Barry, "Balance the Load with Transaction Server," Byte, Jun. 1997, pp. 81-84.
Francett, barbara, "Replication on the Run," Software Magazine, Aug. 1996, pp. 63-66.
Darling, Charles B., EDA/SQL Loses a Little and Gains a Lot, Datamation, May 1, 1996, p. 12.
Varney, Sarah E., "Arm your salesforce with the Web," Datamation, Oct. 1996, pp. 72-74.
Fulcher, Jim, "Is it or isn't it?," Manufacturing Systems, Oct. 1996, pp. 56-61.
Lamb, John and Cusato, Tony, "LAN-Based Office for the Enterprise, A Case Study," Proceedings, 19th Conference on Local Computer Networks, Minneapolis, Minnesota, Oct. 2-5, 1994, pp. 440-447.
Kawell Jr., Leonard et al., "Replicated Document Management In A Group Communication System," presented at the Second Conference on Computer-Supported Cooperative Work, Portland, Oregon, Sep. 26-28, 1988, as printed in Groupware: Software for Computer-Supported Cooperative Work, IEEE Computer Society Press, pp. 226-235.
Hong, Jack et al., "Personal Electronic Notebook with Sharing," Proceedings of the Fourth Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises, Berkley Springs, West Virginia, Apr. 20-22, 1995, pp. 88-94.
Mace, Scott, "DataSync 2.0 enhances synchronization of data," InfoWorld, Jun. 6, 1994, p.28.
Mace, Scott, "Database replication products debut, " InfoWorld, Nov. 15, 1993, p.19.
Gryphon, Robert, "DataSync line matches up," InfoWorld, May 23, 1994, p. 161.
Patterson, John F. et al., "Notification Servers for Synchronous Groupware," Proceedings, ACM 1996 Conference on Computer Supported Cooperative Work, Boston, Massachusetts, Nov. 16-20, 1996, pp. 122-129.
Zhao, Jian and Hoppe, H. Ulrich, "Supporting Flexible Communication in Heterogeneous Multi-User Environments," 1994 IEEE, pp. 442-449.
Gong, Li, "Enclaves: Enabling Secure Collaboration Over the Internet," IEEE Journal on Selected Areas in Communications, vol. 15, No. 3, Apr. 1997, pp. 567-575.
Bruno, Lee, "Directory Services Tie It All Together," Data Communications, Mar. 1997, pp. 75-83.
Guy, Richard G. et al., "Implementation of the Ficus Replicated File System," Proceedings of the Summer 1990 USENIX Conference, Anaheim, California, Jun. 11-15, 1990, pp. 63-70.
Page, Thomas W. Jr. et al., "Management of Replicated Volume Location Data in the Ficus Replicated Data System," Conference Proceedings, USENIX Summer 1991 Technical Conference, Nashville, Tennessee, Jun. 10-14, 1991, pp. 17-29.
Reiher, Peter et al., "Resolving File Conflicts in the Ficus File System," Conference Proceedings, USENIX Summer 1994 Technical Conference, Boston, Massachusetts, Jun. 6-10, 1994, pp. 183-195.
Walker, Bruce et al., "The LOCUS Distributed Operating System," Proceedings of the Ninth ACM Symposium on Operating Systems Principles, Bretton Woods, New Hampshire, Oct. 10-13, 1983, pp. 49-70.
Parker, D. Stott Jr. et al., "Detection of Mutual Inconsistency in Distributed Systems," IEEE Transactions on Software Engineering, vol. SE-9, No. 3, May 1983, pp. 240-246.
Ceri, Stefano et al., "The Case for Independent Updates", Second Workshop on the Management of Replicated Data, Monterey, California, Nov. 12-13, 1992, pp. 17-19.
Downing, Alan R. et al., "OSCAR: A System for Weak-Consistency Replication", Proceedings, Workshop on the Management of Replicated Data, Houston, Texas, Nov. 8-9, 1990, pp. 26-30.
Siegel, Alex et al., "Deceit: A Flexible Distributed File System", Proceedings of the Summer 1990 USENIX Conference, Anaheim, California, Jun. 11-15, 1990, pp. 51-61.
Chutani, Sailesh, "The Episode File System", Conference Proceedings, USENIX Winter 1992 Technical Conference, San Francisco, California, Jan. 20-24, 1992, pp. 43-59.
Seltzer, Margo, "An Implementation of a Log-Structured File System for UNIX", Conference Proceedings, USENIX Winter 1993 Technical Conference, San Diego, California, Jan. 25-29, 1993, pp. 307-326.
Vahalia, Uresh, "Metadata Logging in an NFS Server", Conference Proceedings, USENIX 1995 Technical Conference on UNIX and Advanced Computing Systems, New Orleans, Louisiana, Jan. 16-20, 1995, pp. 265-276.
Lotus Development Corporation, InterNotes Web Publisher Release 4, "InterNotes Web Publisher Guide", 1996, Cambridge, MA.
Lotus Development Corporation, Lotus Notes Release 4, "Database Manager's Guide", 1995, Cambridge, MA.
Lotus Development Corporation, Lotus Notes Release 4, "Administrator's Guide", 1995, Cambridge, MA.
IBM Lotus Technical Library, Lotus Documentation, "Lotus Notes Internet Cookbook for Notes Release 3", Jan. 16, 1996, pp. 1-26.
John Wiley & Sons, Inc. — Wiley Computer Publishing, Falkner, Mike, "How to Plan, develop, and Implement Lotus Notes in Your Organization", 1996, USA4.
Lotus Development Corporation, Lotus Notes Release 4, "Deployment Guide", 1995, Cambridge, MA.
McGraw-Hill, Lamb, John P. and Lew, Peter W., "Lotus Notes Network Design for Notes Release 3 and 4", 1996, Quebecor-Fairfield, PA.
Lotus Notes, "Overview — What is Lotus NotesPump?", including "notes Pump 1.0 Release Notes."
Lotus Development Corporation, Lotus Notes Release 3.1, The groupware standard, "Site and System Planning Guide", 1994, Cambridge, MA.

Lotus Development Corporation, Lotus Notes Release 3.1. The groupwarestandard, "Administrator's Guide Server for NetWare, OS/2, and UNIX", 1994, Cambridge, MA.

IBM Lotus Technical Library, Lotus Documentation, "Lotus Notes Internet Cookbook for Notes Release 4", Feb. 14, 1996, pp. 1-30 http://www-12.lotus.com/ldd/doc/domino_notes/cookbook/cbookv4.nsf/e125003289bf7b3a385256.

IntelliLink Corporation, IntelliLink for Windows Release 3.0, "User's Guide", 1994, Nashua, NH.

Lotus Development Corporation, Lotus Notes Release 4, "Application Developer's Guide", 1995, Cambridge, MA.

Lotus Development Corporation, Lotus Notes Release 3.3 North American Server Edition, "Lotus Notes, the Groupware Standard", 1994, Cambridge, MA.

Sams Publishing, Dahl, Andrew, "Lotus Notes 4 Administrator's Survival Guide", 1996, Indianapolis, IN.

Sams Publishing, Tmaura, et al., "Lotus Notes 4 Unleashed", 1996, Indianapolis, IN.

Advisor Publications — Lotus Notes Advisor, Pyle, Hugh, "The Notes Architecture", 1995.

Advisor Publications — Lotus Notes Advisor, Augun, Adury, "Integrating Lotus Notes with Enterprise Data", 1996.

Advisor Publications — Lotus Notes Advisor, Opyt, Barbara and Dale, Robert, "Use the Internet as Your Lotus Notes WAN", 1996.

Lotus Development Corporation, Lotus Notes Knowledge Base, "What is the Notes Replicator?", 1995, Cambridge, MA.

Lotus Development Corporation, Lotus Notes Knowledge Base, "Firewall Security Overview and How Firewalls Relate to Lotus Notes", 1996, Cambridge, MA.

Network Computing, Frenkel, Garry, "Pumping for Info: Notes and Database Integration", 1996.

IBM Corporation, Hawker, et al., "Secrets to Running Lotus Notes: The Decisions No One Tells You How to Make", 1996, Research Triangle Park, NC.

US 5,373,559, 12/1994, Kaufman et al. (withdrawn)

* cited by examiner

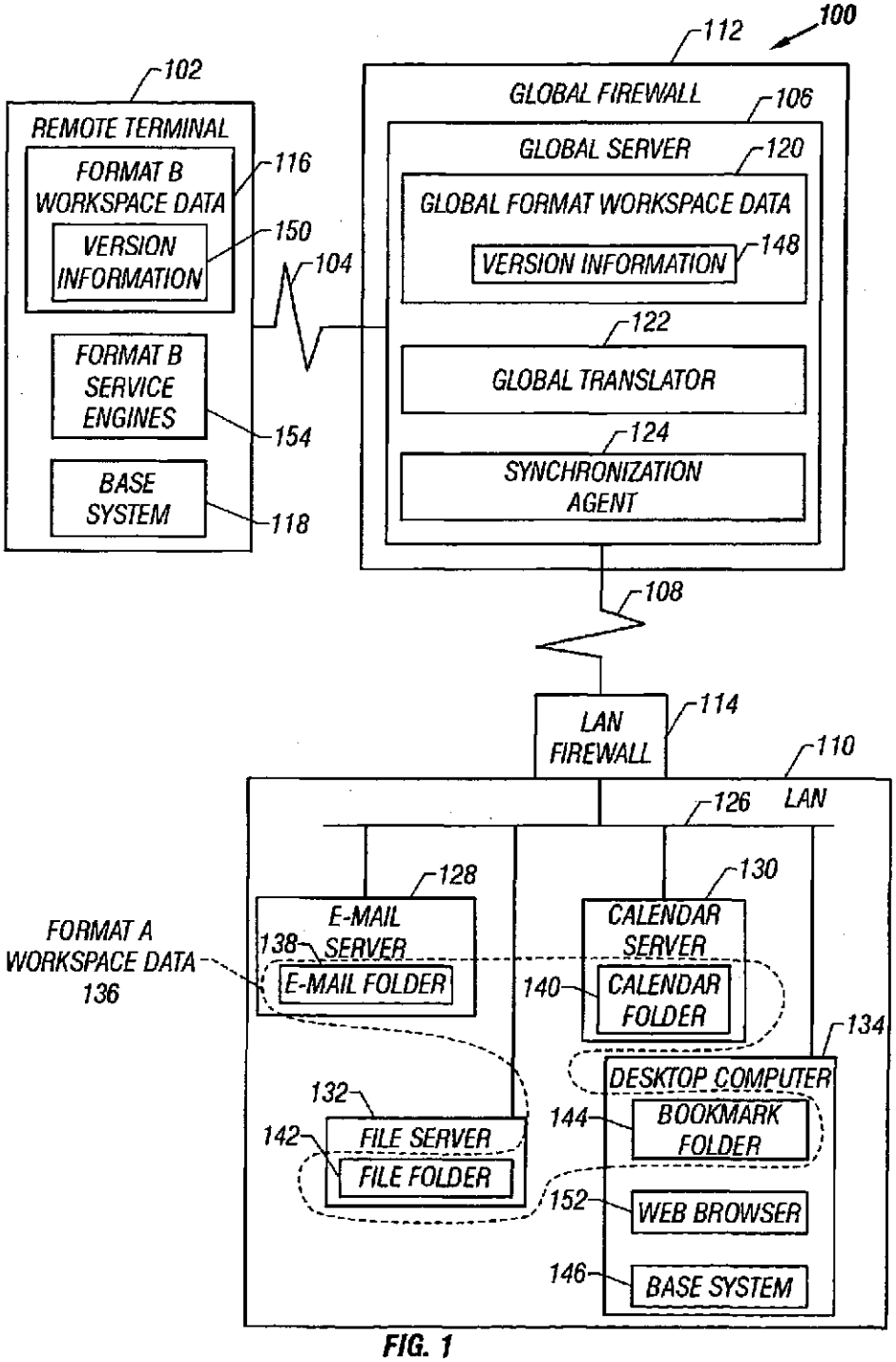

100
112
102
REMOTE TERMINAL
FORMAT B WORKSPACE DATA
116
VERSION INFORMATION
150
104
FORMAT B SERVICE ENGINES
154
BASE SYSTEM
118
GLOBAL FIREWALL
106
GLOBAL SERVER
120
GLOBAL FORMAT WORKSPACE DATA
VERSION INFORMATION
148
122
GLOBAL TRANSLATOR
124
SYNCHRONIZATION AGENT
108
LAN FIREWALL
114
110
126
LAN
128
130
FORMAT A WORKSPACE DATA
136
E-MAIL SERVER
138
E-MAIL FOLDER
CALENDAR SERVER
140
CALENDAR FOLDER
134
DESKTOP COMPUTER
132
FILE SERVER
142
FILE FOLDER
144
BOOKMARK FOLDER
152
WEB BROWSER
146
BASE SYSTEM

FIG. 1

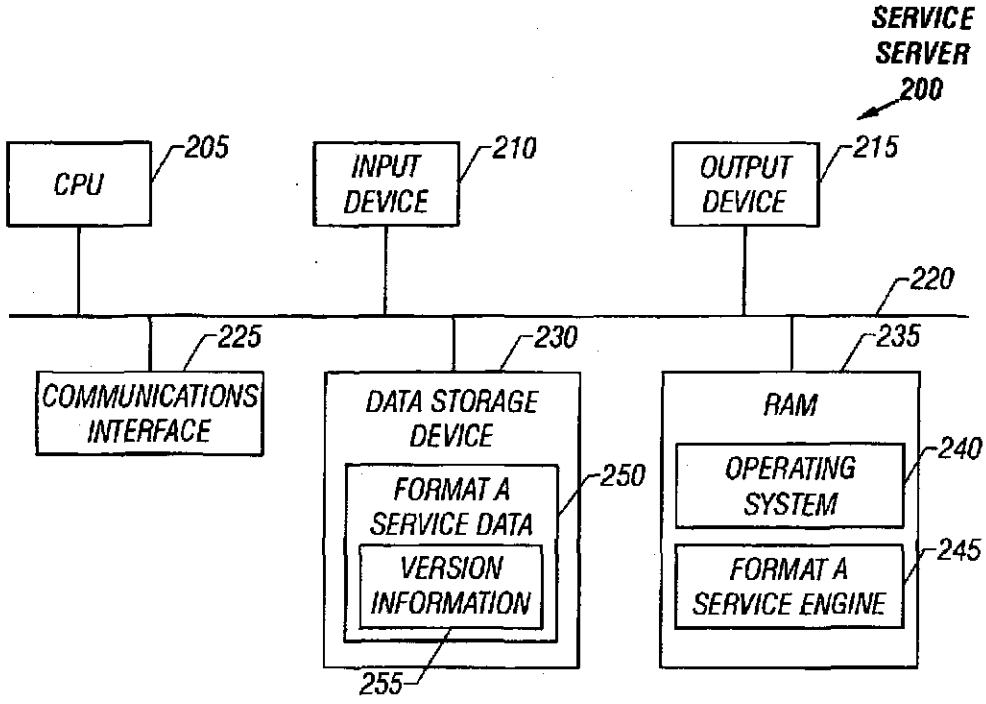

SERVICE SERVER 200
CPU
205
INPUT DEVICE
210
OUTPUT DEVICE
215
220
COMMUNICATIONS INTERFACE
225
DATA STORAGE DEVICE
230
FORMAT A SERVICE DATA
250
VERSION INFORMATION
255
RAM
235
OPERATING SYSTEM
240
FORMAT A SERVICE ENGINE
245

FIG. 2

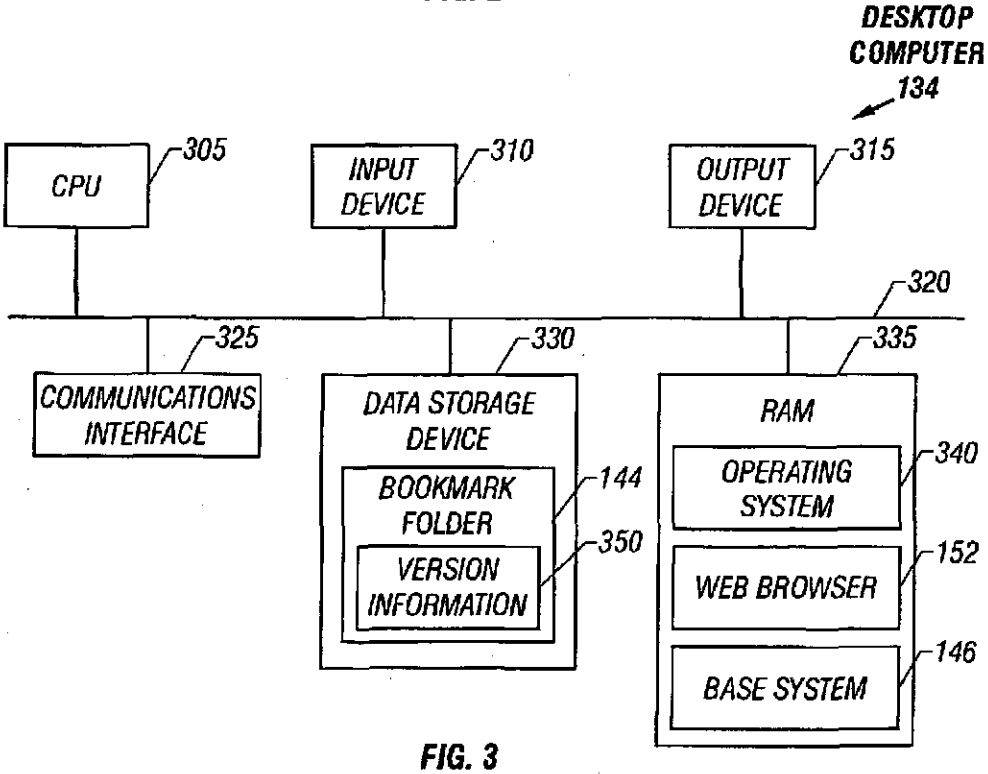

DESKTOP COMPUTER 134
CPU
305
INPUT DEVICE
310
OUTPUT DEVICE
315
320
COMMUNICATIONS INTERFACE
325
DATA STORAGE DEVICE
330
BOOKMARK FOLDER
144
VERSION INFORMATION
350
RAM
335
OPERATING SYSTEM
340
WEB BROWSER
152
BASE SYSTEM
146

FIG. 3

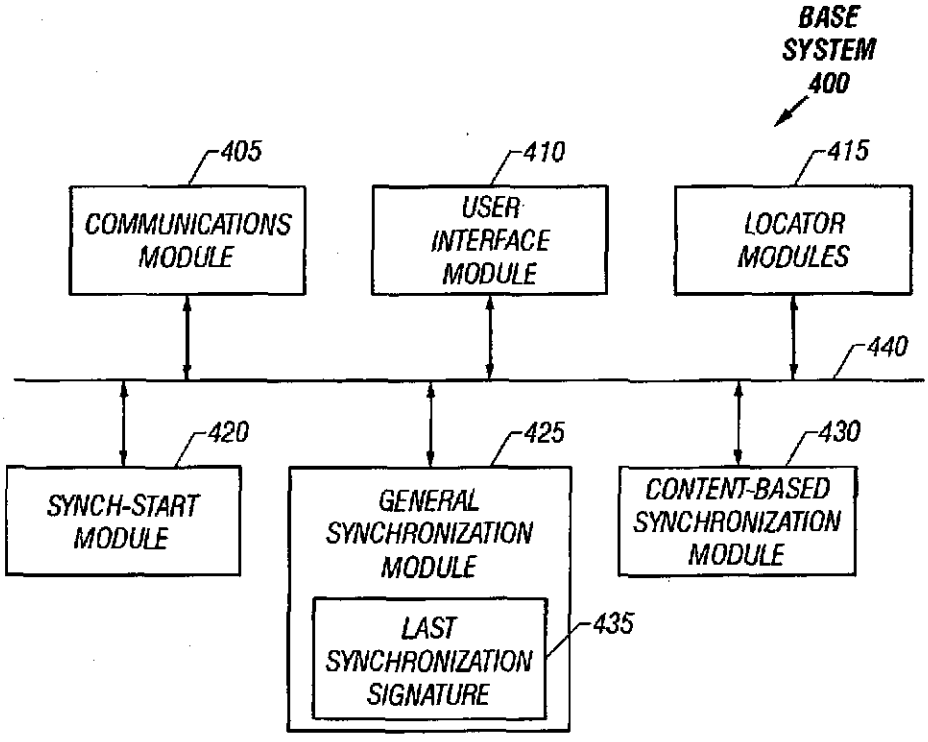

BASE SYSTEM 400
405
COMMUNICATIONS MODULE
410
USER INTERFACE MODULE
415
LOCATOR MODULES
440
420
SYNCH-START MODULE
425
GENERAL SYNCHRONIZATION MODULE
LAST SYNCHRONIZATION SIGNATURE
435
430
CONTENT-BASED SYNCHRONIZATION MODULE

FIG. 4

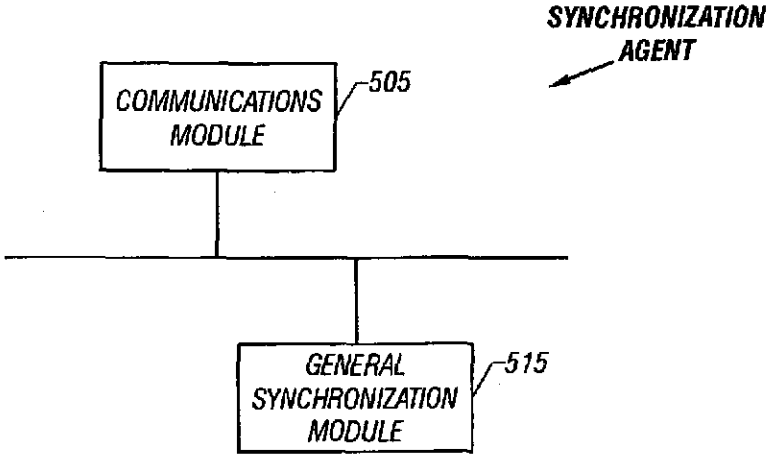

SYNCHRONIZATION AGENT
COMMUNICATIONS MODULE
505
GENERAL SYNCHRONIZATION MODULE
515

FIG. 5

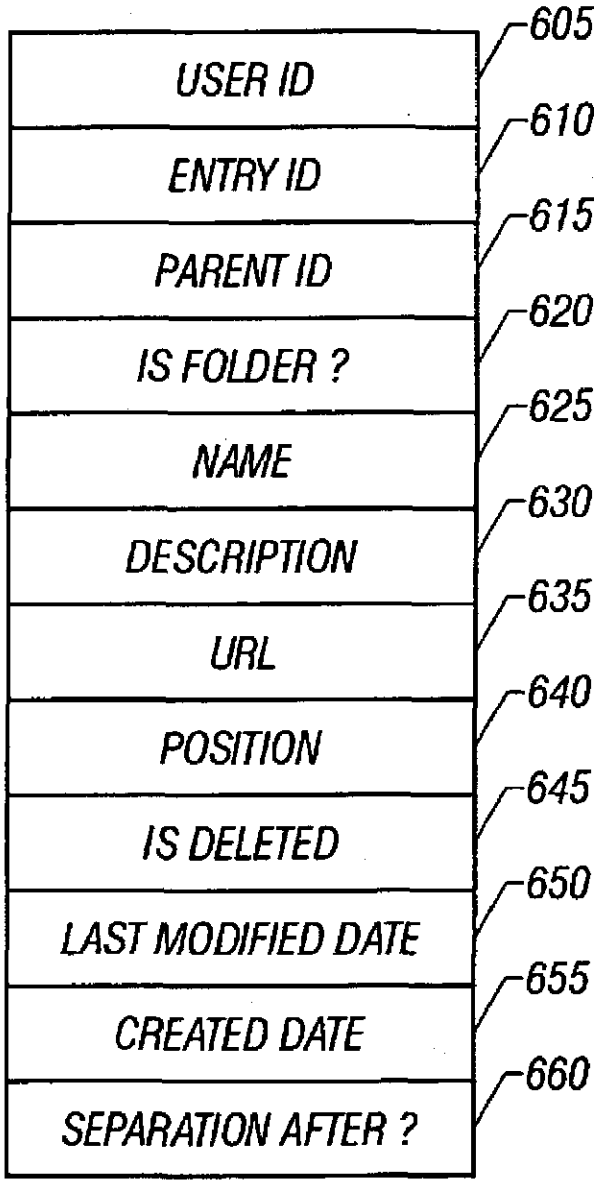

USER ID
605
ENTRY ID
610
PARENT ID
615
IS FOLDER ?
620
NAME
625
DESCRIPTION
630
URL
635
POSITION
640
IS DELETED
645
LAST MODIFIED DATE
650
CREATED DATE
655
SEPARATION AFTER ?
660

FIG. 6

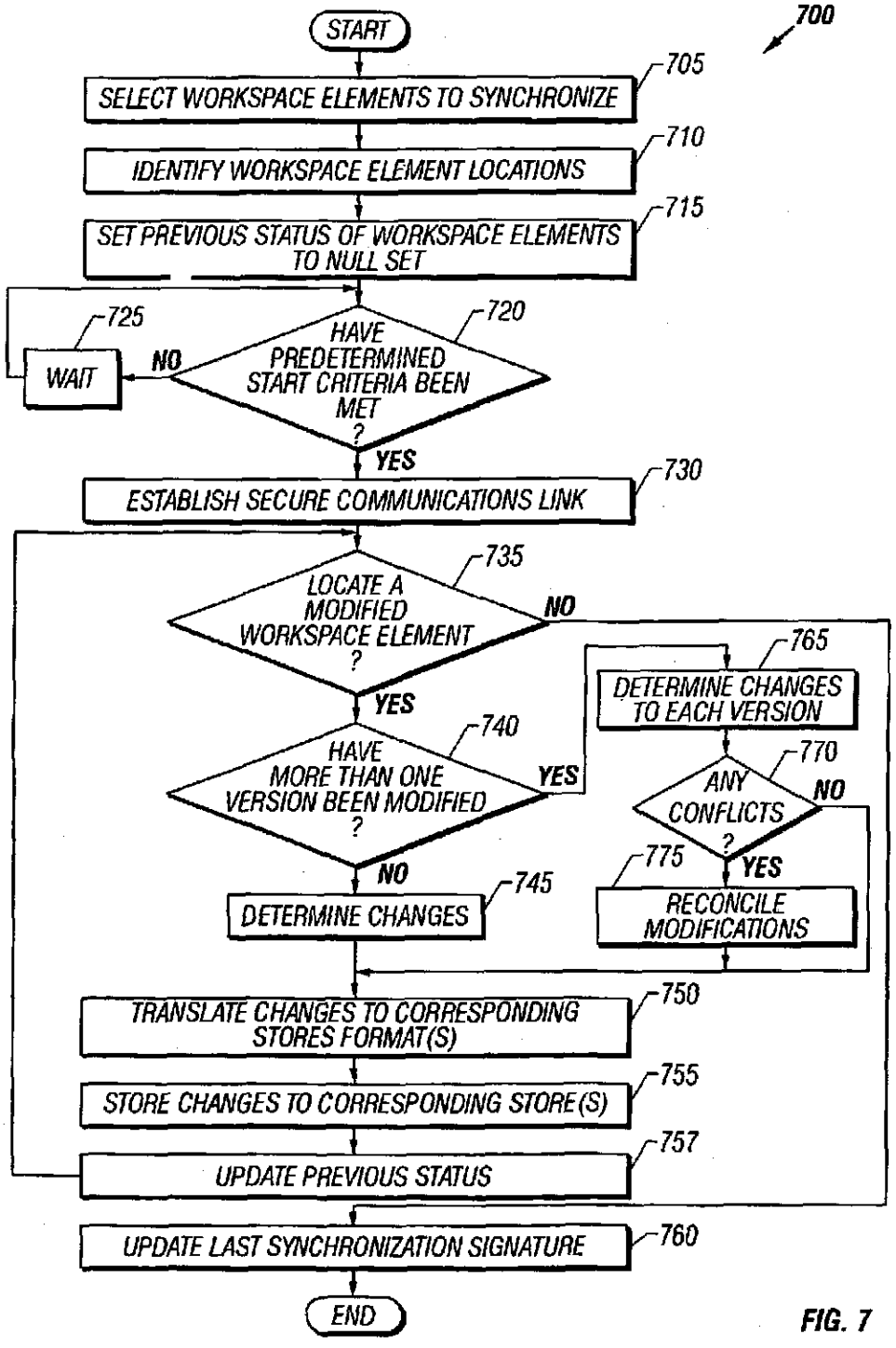

700
START
SELECT WORKSPACE ELEMENTS TO SYNCHRONIZE
705
IDENTIFY WORKSPACE ELEMENT LOCATIONS
710
SET PREVIOUS STATUS OF WORKSPACE ELEMENTS TO NULL SET
715
HAVE PREDETERMINED START CRITERIA BEEN MET ?
720
NO
WAIT
725
YES
ESTABLISH SECURE COMMUNICATIONS LINK
730
LOCATE A MODIFIED WORKSPACE ELEMENT ?
735
NO
YES
HAVE MORE THAN ONE VERSION BEEN MODIFIED ?
740
YES
NO
DETERMINE CHANGES
745
DETERMINE CHANGES TO EACH VERSION
765
ANY CONFLICTS ?
770
NO
YES
RECONCILE MODIFICATIONS
775
TRANSLATE CHANGES TO CORRESPONDING STORES FORMAT(S)
750
STORE CHANGES TO CORRESPONDING STORE(S)
755
UPDATE PREVIOUS STATUS
757
UPDATE LAST SYNCHRONIZATION SIGNATURE
760
END

FIG. 7

SYSTEM AND METHOD FOR TRANSMITTING WORKSPACE ELEMENTS ACROSS A NETWORK

CROSS-REFERENCE TO PRIORITY APPLICATION

This application is a continuation claims priority to the patent application entitled "System and Method for Globally and Securely Accessing Unified Information in a Computer Network," Ser. No. 09/666,877, filed on Sep. 20, 2000, now U.S. Pat. No. 6,708,221 by inventors Daniel J. Mendez, Mark D. Riggins, Prasad Wagle, Hong Q. Bui, Mason Ng, Sean Micheal Quinlan, Christine C. Ying, Christopher R. Zuleeg, David J. Cowan, Joanna A. Aptekar-Strober and R. Stanley Bailes, and hereby incorporates by reference U.S. Pat. No. 6,085,192, issued on Jul. 4, 2000, entitled "System and Method for Securely Synchronizing Multiple Copies of a Workspace Element in a Network," application Ser. No. 08/835,997, filed on Apr. 11, 1997, by inventors Daniel J. Mendez, Mark D. Riggins, Prasad Wagle and Christine C. Ying.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to computer networks, and more particularly to a system and method for using a global translator to synchronize workspace elements such as files across a computer network.

2. Description of the Background Art

Data consistency is a significant concern for computer users. For example, when maintaining multiple independently-modifiable copies of a document, a user risks using an outdated version. By the time the user notices an inconsistency, interparty miscommunication or data loss may have already resulted. The user must then spend more time attempting to reconcile the inconsistent versions and addressing any miscommunications.

The problem of data inconsistency is exacerbated when multiple copies of a document are maintained at different network locations. For example, due to network security systems such as conventional firewall technology, a user may have access only to a particular one of these network locations. Without access to the other sites, the user cannot confirm that the version on the accessible site is the most recent draft.

Data consistency problems may also arise when using application programs from different vendors. For example, the Netscape Navigator™ web browser and the Internet Explorer™ web browser each store bookmarks for quick reference to interesting web sites. However, since each web browser uses different formats and stores bookmarks in different files, the bookmarks are not interchangeable. In addition, one web browser may store a needed bookmark, and the other may not. A user who, for example, runs the Internet Explorer™ web browser at home and runs the Netscape Navigator™ web browser at work risks having inconsistent bookmarks at each location.

Therefore, a system and method are needed for providing users with data consistency, and more particularly for synchronizing multiple copies of a workspace element such as a document across a computer network.

SUMMARY OF THE INVENTION

The present invention provides a system and method for using a global translator to synchronize multiple copies of a workspace element in a secure network environment. The secure network environment includes a global server connected to multiple clients. Using the present system and method, the clients automatically synchronize workspace elements between multiple sites, independent of whether the sites are protected by site firewalls. Using the present system and method, the clients can automatically synchronize workspace elements across different formats and can merge workspace element folders for cross use.

The system includes a first store for storing first workspace elements in a first format, a second store for storing second workspace elements in a second format, a communications channel coupling the first store to the second store, synchronization means for synchronizing first workspace elements and second workspace elements, and a translator for translating between the first format and the second format.

Similarly, the method includes the steps of accessing a first store storing a first workspace element in a first format, accessing a second store storing a second workspace element in a second format, synchronizing the first workspace element and the second workspace element, and translating between the first format and the second format.

The system and method advantageously use a trusted third party to enable the synchronization of workspace data among multiple sites. Accordingly, a client user who maintains a work site, a home site, an off-site and the global server site can synchronize the workspace data or portions thereof among all four sites. Further, the predetermined criteria (which control when the synchronization-start module initiates synchronization) may be set so that the general synchronization module synchronizes the workspace data upon user request, at predetermined times during the day such as while the user is commuting, or after a predetermined user action such as user log-off or user log-on. Because the system and method operate over the Internet, synchronization can occur over any distance. Since the system and method include format translation, merging of workspace elements between different application programs and different platforms is possible. Further, because synchronization is initiated from within the firewall, the typical firewall which prevents in-bound communications does not act as an impediment to workspace element synchronization. Also, since the user's preferences may be previously set, the present system and method may operate unattended by the client user.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a computer network in accordance with the present invention;

FIG. **2** is a block diagram illustrating details of a FIG. **1** service server;

FIG. **3** is a block diagram illustrating details of the FIG. **1** desktop computer;

FIG. **4** is a block diagram illustrating details of a FIG. **1** base system;

FIG. **5** is a block diagram illustrating details of the FIG. **1** synchronization agent;

FIG. **6** is a graphical representation of an example bookmark in the global format; and

FIG. **7** is a flowchart illustrating a method for synchronizing multiple copies of a workspace element in a secure network.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** is a block diagram illustrating a computer network **100**, comprising a first node such as a remote computer terminal **102** coupled via a communications channel **104**

such as the Internet to a global server **106**. The global server **106** is in turn coupled via a communications channel **108** such as the Internet to a second node such as a Local Area Network (LAN) **110**. The global server **106** is protected by a global firewall **112**, and the LAN **110** is protected by a LAN firewall **114**.

The LAN **110** includes a system bus **126** coupling the LAN firewall **114** to an e-mail server **128** having an e-mail folder **138** containing e-mails, to a file server **132** having a file folder **142** containing files, to a calendar server **130** having a calendar folder **140** containing calendar data, and to a desktop computer **134** having a web browser **152** and a bookmark folder **144** containing bookmarks. It will be appreciated that the e-mail folder **138**, file folder **142**, calendar folder **140** and bookmark folder **144** or portions thereof may be stored at different locations such as on the desktop computer **134**. The e-mail folder **138**, file folder **142**, calendar folder **140** and bookmark folder **144** are exemplary, grouped by like information and are collectively referred to herein as "workspace data" **136**. Those skilled in the art will recognize that the workspace data **136** may include other types of data such as an application program such as Microsoft Word 6.0.1 and the documents created using them. It will be further appreciated that the e-mail folder **138**, file folder **142**, calendar folder **140** and bookmark folder **144** may each be divided into workspace elements, wherein each workspace element folder or each workspace element individually is identified by particular version information **255** (described below with reference to FIG. **2**). Accordingly, each e-mail or e-mail folder, file or file folder, calendar or calendar folder, bookmark or bookmark folder, document or document folder, etc. may be referred to as "a workspace element."

Each workspace element of workspace data **136** in LAN **110** is maintained in a predetermined format, referred to as Format A, which is based on the service engine **245** (FIG. **2**) that created it. For example, the web browser **152** on the desktop computer **134** may be the Netscape Navigator™ web browser, and the bookmarks in the bookmark folder **144** created thereby are maintained in Format A. Although Format A is being described as a single format, one skilled in the art knows that Format A actually includes a format for each information type, e.g., there will be a Format A for bookmarks, a Format A for files, a Format A for calendar data, a Format A for e-mails, etc.

The remote terminal **102** stores service engines **154** for maintaining workspace data **116**, which may include information common with information in the workspace data **136**. The workspace data **116** is maintained in a format, referred to as Format B, which may be different from Format A. Format B is also based on the service engines **154** that create the workspace elements. For example, if one of the service engines **154** is the Internet Explorer™ web browser (not shown), then the bookmarks (not shown) created therewith are maintained in Format B. Although Format B is being described as a single format, one skilled in the art knows that Format B actually includes a format for each information type. Further, the workspace data **116** also includes version information **150** similar to version information **255** described below with reference to FIG. **2**.

It will be appreciated that remote terminal **102** may include a smart telephone, a Personal Data Assistant (PDA) such as the PalmPilot system by the U.S. Robotics, Inc., a laptop computer, etc. As a smart telephone, the workspace data **116** may include telephone numbers and e-mails. As a PDA, the workspace data **116** may include addresses, calendar data and e-mails. As a laptop computer, the workspace data **116** may include the same types of information as workspace data **136**.

The global server **106** acts as a third party administrator. The global server **106** stores independently-modifiable copies of selected portions of the workspace data **136** and **116**, collectively referred to herein as workspace data **120**. Accordingly, the workspace data **120** includes an independently-modifiable copy of each workspace element in the selected portions of the workspace data **136** and **116** and an independently-modifiable copy of each corresponding version information **255** (FIG. **2**) and **150**. The version information copies are collectively referred to herein as version information **148**, and are also described with reference to FIG. **2**.

The global server **106** maintains the workspace data **120** in a format, referred to as a "global format," which is selected to be easily translatable by the global translator **122** to and from Format A and to and from Format B. Although the global format is being described as a single format, one skilled in the art knows that the global format actually includes a global format for each information type, e.g., there will be a global format for bookmarks, a global format for files, a global format for calendar data, a global format for e-mails, etc. An example bookmark workspace element in the global format is described in detail below with reference to FIG. **6**.

Network **100** further comprises synchronization means, which includes a base system **146** stored within the LAN **110** and for example on the desktop computer **134**. Network **100** further includes a synchronization agent **124** stored outside the LAN firewall **114** and preferably on the global server **106**. The base system **146** and the synchronization agent **124** cooperate to synchronize selected portions of the workspace data **136** with selected portions of the workspace data **120**. The synchronization means may synchronize workspace elements individually, e.g., specific word processor documents, or may synchronize workspace element folders, e.g., a bookmark folder. Generally, the base system **146** manages the selected portion of the workspace data **136** within the LAN **110** and the synchronization agent **124** manages the selected portions of the workspace data **120** within the global server **106**. It will be appreciated that the global translator **122** cooperates with the synchronization means to translate data formats to and from the global format. As described in greater detail below with reference to FIG. **4**, the base system **190** preferably initiates and controls data synchronization. Other components and functions of the global server **106** are described in the cross-referenced patent application which is herein incorporated by reference.

The synchronization means may also include, stored on the remote terminal **102**, a base system **118** which operates in a similar manner to the base system **146**. The base system **118** on the remote terminal **102** cooperates with the synchronization agent **124** to synchronize selected portions of the workspace data **116** with selected portions of the workspace data **120**. As described in greater detail below with reference to FIG. **4**, the base system **118** on the remote terminal **102** also preferably initiates and controls data synchronization with the global server **106**. Also, note that the distribution of labor between the base system **118** in the remote terminal **102** and the synchronization agent **124** in the global server **106** may vary. Sometimes, primarily when the remote terminal **102** is a relatively less computationally powerful device (such as a smart phone or a PDA), most of the actual computationally-intensive work will occur within the synchronization agent **124** in the global server **106**. In

other situations, for example, when the remote terminal **102** is a fully configured PC, most of the computationally-intensive work will occur locally on the base system **118** in the remote terminal **102**.

Accordingly, the synchronization means independently synchronizes the selected portions of workspace data **116** and **136** with the selected portions of the workspace data **120**. Thus, the synchronization means indirectly synchronizes workspace data **136** with workspace data **116**.

FIG. **2** is a block diagram illustrating details of a service server **200**, wherein each of the e-mail server **145**, the file server **150**, the calendar server **155** and the desktop computer **160** is an instance thereof. Service server **200** includes a Central Processing Unit (CPU) **205** such as an Intel Pentium® microprocessor or a Motorola Power PC® microprocessor. An input device **210** such as a keyboard and mouse and an output device **215** such as a Cathode Ray Tube (CRT) display are coupled via a signal bus **220** to CPU **205**. A communications interface **225** (such as an Ethernet port), a data storage device **230** (such as a magnetic disk), and Random-Access Memory (RAM) **235** are further coupled via signal bus **220** to the CPU **205**.

An operating system **240** includes a program for controlling processing by the CPU **205**, and is typically stored in the data storage device **230** and loaded into the RAM **235** for execution. A service engine **245** includes a program for performing a particular service such as maintaining an e-mail data base, a file data base, a calendar data base or a bookmarks data base. The service engine **245** may also be stored in the data storage device **230** and loaded into the RAM **235** for execution.

To perform a service, the service engine **245** creates service data **250** (e.g., an e-mail or an e-mail folder **138** containing e-mails, a file or a file folder **142** containing files, calendar data or a calendar folder **140** containing calendar data, a bookmark or a bookmark folder **144** containing bookmarks, etc.) in Format A according to predetermined protocols. The service engine **245** stores the data **250** in the data storage device **250**. The service data **250** includes version information **255** indicating the date and time of the last modification and the status as of the last interaction with the global server **106**.

For example, if service data **250** is created and selected to be merged with global server workspace data **120**, then the version information **255** for the service data **250** may include the date of last modification and a null set indicating the status as of the last interaction with the global server **106**. From the version information **255**, the base system **146** determines that the service data **250** in its entirety has not been merged with the global server workspace data **120**. Similarly, if the service data **255** included elements **1**, **2** and **3** as of the last modification, then the previous status as of the last interaction will indicate that the service data **255** included elements **1**, **2** and **3**. If the service data **255** currently includes elements **2**, **3** and **4**, then the base system **140** will determine, that, since last synchronization, element **1** has been deleted and element **4** has been added.

It will be appreciated that the version information **148** on the global server **106** includes information similar to version information **255**. That is, the version information **148** will include information indicating the date and time the version was last modified and the status as of the last interaction with each client. The service engine **245** operates to update the version information **255** after modifications are made and after synchronization occurs.

FIG. **3** is a block diagram illustrating details of the desktop computer **160**, which includes a CPU **305**, an input device **310**, an output device **315**, a communications interface **325**, a data storage device **330** and RAM **335**, each coupled to a signal bus **320**.

An operating system **340** includes a program for controlling processing by the CPU **305**, and is typically stored in the data storage device **330** and loaded into the RAM **335** for execution. A web browser **152** (i.e., a particular service engine **245**, FIG. **2**) includes a Format A service program for managing bookmark folder **144** (i.e., particular service data **250**, FIG. **2**) which includes version information **350** (i.e., particular version information **255**, FIG. **2**). The web browser **152** may be also stored in the data storage device **330** and loaded into the RAM **335** for execution. The bookmark folder **144** may be stored in the data storage device **330**. As stated above with reference to FIG. **1**, the base system **146** operates to synchronize the workspace data **136** (which includes the bookmark folder **144**) with the workspace data **120**. The base system **146** may be also stored in the data storage device **330** and loaded into the RAM **335** for execution.

FIG. **4** is a block diagram illustrating details of the base system **400**, which exemplifies base systems **146** and **118**. Base system **400** includes a communications module **405**, a user interface module **410**, locator modules **415**, a synchronization-start ("synch-start") module **420**, a general synchronization module **425** and a content-based synchronization module **430**. For simplicity, each module is illustrated as communicating with one another via a signal bus **440**.

The communications module **405** includes routines for compressing data and routines for communicating via the communications interface **325** (FIG. **3**) with the synchronization agent **124** (FIG. **1**). The communications module **405** may further include routines for applying Secure Socket Layer (SSL) technology and user identification and authentication techniques (i.e., digital certificates) to establish a secure communication channel through the global firewall **112**. Examples of communications modules **405** may include TCP/IP stacks or the AppleTalk® protocol.

The user interface module **410** includes routines for communicating with a user, and may include a conventional Graphical User Interface (GUI). The user interface module **410** cooperates with the other system components as described herein.

The locator modules **415** include routines for identifying the memory locations of the workspace elements in the workspace data **136** or **116** and in the workspace data **120**. Workspace element memory location identification may be implemented using intelligent software, i.e., preset memory addresses or the system's registry, or using dialogue boxes to query a user. More particularly, the locator modules **415** in the base system **146** determine the memory addresses of the e-mail folder **138**, the file folder **142**, the calendar folder **140** and the bookmark folder **144** and the memory addresses of the workspace elements therein. The locator modules **415** also determine the corresponding memory addresses of the corresponding folders in the workspace data **120** and the corresponding workspace elements therein. Similarly, the locator modules **415** in the base system **118** determine the memory locations of the workspace elements of workspace data **116** and the memory locations of the corresponding workspace elements in the workspace data **120**.

It will be appreciated that the locator modules **415** may include locator modules **415** specifically dedicated to each folder or workspace data type. That is, the locator modules **415** may include a locator module **415** dedicated to locating bookmarks, a locator module **415** dedicated to locating e-mails, a locator module **415** dedicated to locating files, a

locator module **415** dedicated to locating calendar appointments, etc. It will be further appreciated that the locator modules **415** may perform workspace element memory location identification upon system boot-up or after each communication with the global server **120** to maintain updated memory addresses of workspace elements.

The synchronization-start module **420** includes routines for determining when to initiate synchronization of workspace data **136** or **116** with workspace data **120**. For example, the synchronization-start module **420** may initiate data synchronization upon user request, at a particular time of day, after a predetermined time period passes, after a predetermined number of changes, after a user action such as user log-off or upon like criteria. The synchronization-start module **420** initiates data synchronization by instructing the general synchronization module **425** (described below) to begin execution of its routines. It will be appreciated that communication with the synchronization agent **124** preferably initiates from within the LAN **110**, because the typical firewall **114** prevents in-bound communications and allows out-bound communications.

The general synchronization module **425** includes routines for receiving version information **148** for modified versions from the synchronization agent **124** (FIG. 1), and routines for examining the version information **255** or **150** against a last synchronization signature **435** (such as a last synchronization date and time) to determine which versions have been modified. The general synchronization module **425** further includes routines for examining the version information **148** and the version information **255** or **150** to determine if one or both versions of a particular workspace element or workspace element folder have been modified.

Further, the general synchronization module **425** includes routines for performing an appropriate synchronizing responsive action. Appropriate synchronizing responsive actions may include, if only one version of a workspace element in workspace data **136** or **116** has been modified, then forwarding the modified version (as the preferred version) to the other store(s) or determining and forwarding only the changes made. Computing the changes made may be performed by examining the current status against the previous status as of the last synchronization or by comparing the two versions. It will be appreciated that no content-based review of the changes is needed. It will be appreciated that one store preferably forwards only the changes to the other store for optimizing use of processor power and minimizing the data communications across the communications channel **108** or **104**.

Other appropriate synchronizing responsive actions may include, if two versions of a workspace element have been modified independently, then instructing the content-based synchronization module **430** (described below) to execute its routines. That is, if two versions of the same workspace element have been modified independently, then a content-based review of the changes is preferable. Upon completion of the data synchronization, the general synchronization module **425** updates the last synchronization signature **435**.

The content-based synchronization module **430** includes routines for reconciling two or more modified versions of a workspace element. For example, if a user has independently modified the original and the copy of a workspace element since the last synchronization, then the content-based synchronization module **430** determines an appropriate responsive action. The content-based synchronization module **430** may request the user to select a preferred one of the modified versions or may respond based on preset preferences, i.e., by storing both versions in both stores or preferably by integrating the modified versions into a single preferred version which replaces each modified version at both stores.

The content-based synchronization module **430** examines the changes made to each version and determines if conflicts exist. When implementing version integration, a conflict may arise if inconsistent modifications such as deleting a paragraph in one version and modifying the same paragraph in the other version have been made. If a conflict exists, then the content-based synchronization module **430** attempts to reconcile the conflict, e.g., by requesting user selection or by storing both versions at both stores. Otherwise, if no conflict exists, then the content-based synchronization module **430** integrates the changes to each of the versions and updates the version information **148**, **150** or **255** accordingly.

FIG. **5** is a block diagram illustrating details of the synchronization agent **124**, which includes a communications module **505** (similar to the communications module **405** described above with reference to FIG. **4**) and a general synchronization module **515** (similar to the general synchronization module **425** described above also with reference to FIG. **4**).

The communications module **505** includes routines for compressing data, and routines for communicating via the communications channel **108** with the base system **146** or via the communications channel **104** with the base system **118**. The communications module **505** may further include routines for establishing a secure communications channel through the global firewall **112** and through the LAN firewall **114** with the communications module **405**.

Similar to the general synchronization module **425**, the general synchronization module **515** includes routines for examining the version information **148** and the last synchronization signature **435** (FIG. **4**) to determine which versions have been modified and the changes made. It will be appreciated that the general synchronization module **515** may maintain its own last synchronization signature **435** copy (not shown) or may request the last synchronization signature **435** from the base system **146** or **118**. The general synchronization module **515** further includes routines for forwarding workspace data **120** determined to be modified to the general synchronization module **425**, and routines for receiving preferred versions of workspace elements of workspace data **136** or **116** or just the changes from the general synchronization module **425**.

FIG. **6** illustrates an example bookmark workspace element in the global format. The global translator **122** incorporates all the information needed by both formats (Format A and Format B) to create the Global Format. For example, if a bookmark in Format A needs elements X, Y and Z and a bookmark in Format B needs elements W, X and Y, the global translator **122** incorporates elements W, X, Y and Z to create a bookmark in the Global Format. Further, the global translator **122** incorporates the information which is needed by the synchronization means such as the last modified date. Accordingly, a bookmark in the Global Format includes a user identification (ID) **605**, an entry ID **610**, a parent ID **615**, a folder ID flag **620**, a name **625**, a description **630**, the Uniform Resource Locator (URL) **635**, the position **640**, a deleted ID flag **645**, a last modified date **650**, a created date **655** and a separation ID flag **660**.

FIG. **7** is a flowchart illustrating a method **700** for using a global translator **122** to synchronize multiple copies of a workspace element in a secure network **100**. Method **700** begins with the user interface module **410** in step **705** enabling a user to select workspace elements of workspace data **136** and **118** for the synchronization means to synchro-

nize. The locator modules **415** in step **710** identify the memory locations of the workspace elements in workspace data **136** and **116** and the corresponding memory locations in workspace data **120**. If a selected workspace element does not have a corresponding memory location, such as in the case of adding a new workspace elements to the global server **106**, then one is selected. The selected memory location may be a preexisting workspace element or a new workspace element. As stated above, workspace element memory location identification may be implemented using intelligent software or dialogue boxes. The general synchronization module **425** and general synchronization module **515** in step **715** set the previous status of the workspace elements equal to the null set. Setting the previous status to the null set indicates that all information of the workspace element has been added.

The synchronization-start module **420** in step **720** determines whether predetermined criteria have been met which indicate that synchronization of the workspace elements selected in step **705** should start. If not, then the synchronization-start module **420** in step **725** waits and loops back to step **720**. Otherwise, the communications module **405** and communications module **505** in step **730** establish a secure communications channel therebetween.

The general synchronization module **425** and the general synchronization module **515** in step **735** determine whether any workspace elements have been modified. That is, the general synchronization module **425** in step **740** examines the version information **255** or **150** of each selected workspace element in the workspace data **136** or **116** against the last synchronization signature **435** to locate modified workspace elements. This comparison may include comparing the date of last modification with the date of last synchronization, or may include a comparison between the current status and the previous status as of the last interaction. Similarly, the general synchronization module **515** examines the version information **148** of each corresponding workspace element in workspace data **120** and the last synchronization signature **435** to locate modified workspace elements.

If in step **735** no modified workspace elements or folders are located, then the general synchronization modules **425** and **515** in step **760** update the last synchronization signature **435** and method **700** ends. Otherwise, the general synchronization module **425** in step **740** determines whether more than one version of a workspace element has been modified since the last synchronization.

If only one version has been modified, then the corresponding general synchronization module **425** or **515** in step **745** determines the changes made. As stated above, determining the changes made may be implemented by comparing the current status of the workspace element against the previous status of the workspace element as of the last interaction therebetween. If the changes were made only to the version in the workspace data **120**, then the global translator **122** in step **750** translates the changes to the format used by the other store, and the general synchronization module **515** in step **755** forwards the translated changes to the general synchronization module **425** for updating the outdated workspace element in the workspace data **136** or **116**. If the updated version is a workspace element in the workspace data **136** or **116**, then the general synchronization module **425** sends the changes to the updated version to the global translator **122** for translation and then to the general synchronization module **515** for updating the outdated workspace element in the workspace data **120**. The general synchronization module **425** and the general synchronization module **515** in step **757** update the previous state of to reflect the current state as of this interaction. Method **700** then returns to step **735**.

If the general synchronization module **425** in step **740** determines that multiple versions have been modified, then the general synchronization module **425** in step **765** computes the changes to each version and in step **770** instructs the content-based synchronization module **430** to examine content to determine if any conflicts exist. For example, the content-based synchronization module **430** may determine that a conflict exists if a user deletes a paragraph in one version and modifies the same paragraph in another version. The content-based synchronization module **430** may determine that a conflict does not exist if a user deletes different paragraphs in each version. If no conflict is found, then method **700** jumps to step **750** for translating and forwarding the changes in each version to the other store. However, if a conflict is found, then the content-based synchronization module **430** in step **775** reconciles the modified versions. As stated above, reconciliation may include requesting instructions from the user or based on preselected preferences performing responsive actions such as storing both versions at both stores. Method **700** then proceeds to step **750**.

It will be appreciated that in step **710** new workspace elements and preexisting workspace elements to which new workspace elements will be merged are set to "modified" and the previous status is set to the null set. Thus, the general synchronization module **425** in step **740** will determine that more that one version has been modified and the content-based synchronization module **430** in step **770** will determine that no conflict exists. The changes in each will be translated and forwarded to the other store. Accordingly, the two versions will be effectively merged and stored at each store.

For example, if a first bookmark folder was created by the web browser **152** on the desktop computer **134**, a second folder was created by a web browser (not shown) on the remote terminal **102**, no preexisting folder existed on the global server **106** and the user selected each of these folders for synchronization, then the synchronization means will effectively merge the first and second folders. That is, the general synchronization module **425** on the desktop computer **134** will determine that the first folder has been modified and the previous status is equal to the null set. The general synchronization module **425** will determine and send the changes, i.e., all the workspace elements in the first folder, to a new global folder on the global server **106**. Similarly, the general synchronization module **425** on the remote terminal **102** will determine that, as of its last interaction, the previous status of each of the second and the global folders is the null set. The general synchronization module **425** will instruct the content-based synchronization module **430** to examine the changes made to each folder to determine whether a conflict exists. Since no conflicts will exist, the general synchronization module **425** will forward the changes to the global folder and the general synchronization module **515** will forward its changes to the second store, thereby merging the workspace elements of the first and second folders in the global and second folders. The general synchronization module **515** will inform the general synchronization module **425** that the global folder has been modified relative to the last interaction, and will forward the new changes to the first folder. Thus, the first and second folders will be merged and stored at each store.

For a second example, the user may select an exemplary document in the LAN **110** to be synchronized. The general synchronization module **425** will forward the document to

the global server **106**. Similarly, the user may select the same document for synchronization on the remote terminal **102**. The general synchronization module **515** will forward the document to the remote terminal **102**. If changes were made to the documents independently, then the content-based synchronization module **430** will examine the content of the documents to determine if a conflict exists. If no conflict exists, then as described above, the general synchronization modules **425** and **515** will merge the documents. Otherwise, if a conflict does exist, the content-based synchronization module **430** will reconcile the changes and then the general synchronization modules **425** and **515** will forward the reconciled changes to each other.

The foregoing description of the preferred embodiments of the invention is by way of example only, and other variations of the above-described embodiments and methods are provided by the present invention. For example, although the global server **106** is illustrated as a single device, the global server **106** may include several computers networked together. Components of this invention may be implemented using a programmed general purpose digital computer, using application specific integrated circuits, or using a network of interconnected conventional components and circuits. The embodiments described herein have been presented for purposes of illustration and are not intended to be exhaustive or limiting. Many variations and modifications are possible in light of the foregoing teaching. The system is limited only by the following claims.

What is claimed is:

1. A method, comprising:

providing a first memory store including a first folder for storing first record entries in a file;

providing a second memory store coupled to the first memory store, the second memory store including a second folder for storing second record entries in a file, the second folder being synchronized with the first folder at a first moment in time such that a content of the second folder is consistent with the content of the first folder at the first moment in time;

providing a global server including a third memory store having a third folder for storing third record entries in a file;

receiving new first record entries in a file at the first memory store at a second moment in time later than the first moment in time;

electronically synchronizing the first folder and the third folder, such that a new third record entry is created in the third folder based on the new first record entries; and

electronically synchronizing the third folder and the second folder, such that a new second record entry is created in the second folder based on the new third record entry.

2. A system, comprising:

a first memory store including a first folder for storing first record entries in a file;

a second memory store coupled to the first memory store the second memory store including a second folder for storing second record entries in a file, the second folder being synchronized with the first folder at a first moment in time such that a content of the second folder is consistent with the content of the first folder at the first moment in time;

an interface for receiving new record entries in a file at the first memory store;

a general synchronization module for electronically synchronizing the first folder and a third folder such that a anew third record entry is created in the third folder based on the new first record entries; and

a synchronization agent for electronically synchronizing the third folder and the second folder such that a new second record entry is created in the second folder based on the new third record entry.

3. A system, comprising:

first memory means including a first folder for storing first record entries in a file;

second memory means coupled to the first memory means, the second memory means including a second folder for storing second file entries in a file, the second folder being synchronized with the first folder at a first moment in time such that a content of the second folder is consistent with the content of the first folder at the first moment in time;

providing a global server including a third memory means having a third folder for storing third record entries in a file;

means for receiving new record file entries at the first memory means;

means for electronically synchronizing the first folder and the third folder such that a new third record entry is created in the third folder based on the new first record entries; and

means for electronically synchronizing the third folder and the second folder, such that a new second record entry is created in the second folder based on the new third record entry.

4. A method, comprising:

providing a first memory store including a first folder for storing first record entries in a file;

providing a second memory store coupled to the first memory store, the second memory store including a second folder for storing second record entries in a file the second folder being synchronized with the first folder at a first moment in time such that a content of the second folder is consistent with the content of the first folder at the first moment in time;

providing a global server including a third memory store having a third folder for storing third record entries in a file;

receiving changes at the first memory store;

electronically synchronizing the first folder and the third folder such that the content of the changes creates a third record entry; and

electronically synchronizing the third folder and the second folder such that a new second record entry is created in the second folder based on the third record entry.

5. A system, comprising:

a first memory store including a first folder for storing first record entries in a file;

a second memory store coupled to the first memory store, the second memory store including a second folder for storing second record entries in a file, the second folder being synchronized with the first folder at a first moment in time such that a content of the second folder is consistent with the content of the first folder at the first moment in time;

providing a global server including a third memory store having a third folder for storing third record entries in a file;

an interface for receiving changes at the first memory store;

a general synchronization module for electronically synchronizing the first folder and the third folder such that the content of the changes creates a third record entry; and

a synchronization agent for electronically synchronizing the third folder and the second folder such that a new second record entry is created in the second folder based on the third record entry.

6. A system, comprising:

first memory means including a first folder for storing first record entries in a file;

second memory means coupled to the first memory means the second memory means including a second folder for storing second file entries in a file, the second folder being synchronized with the first folder at a first moment in time such that a content of the second folder is consistent with the content of the first folder at the first moment in time;

providing a global server including a third memory means having a third folder for storing third record entries in a file;

means for receiving changes at the first memory means;

means for electronically synchronizing the first folder and the third folder such that the content of the changes creates a third record entry; and

means for electronically synchronizing the third folder and the second folder, such that a new second record entry is created in the second folder based on the new third record entry.

* * * * *